

DERWENT-ACC-NO: 1999-112085  
DERWENT-WEEK: 199910  
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TITLE: Pressure treatment equipment for plate-shaped body  
e.g. silicon wafer  
used in ULSI - has handling robot that performs insertion  
and removing of  
silicon wafer to and from process chamber which is divided  
by vertical  
components of pressurized container

PATENT-ASSIGNEE: KOBE STEEL LTD[KOBM]

PRIORITY-DATA: 1997JP-0137240 (May 27, 1997)

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INT-CL (IPC): H01L021/31; H01L021/68 ; H01L021/768

ABSTRACTED-PUB-NO: JP10335408A

BASIC-ABSTRACT: NOVELTY - A handling robot performs the  
insertion and removal

of a silicon substrate (A) to and from a process chamber  
which is divided by

the vertical components (2,3) of a pressurized container  
(1). A support stand

(7A) for the silicon wafer is provided in the process  
chamber. DETAILED

DESCRIPTION - The equipment has a sealing unit (5) provided  
in the divided

portion of the process chamber, to prevent the leakage of  
fluid. An elevation

unit (6) raises the bottom vertical component to-a

container axial direction.

USE - For performing e.g. hot isotropic press (HIP) process, high-pressure gas oxidation and nitriding process to the plate shaped body.

ADVANTAGE - Ensures the silicon wafer pressure application process without using wafer moving actuator in the pressurized container. Ensures a highly reliable and accurate pressure application to silicon wafer. DESCRIPTION OF

DRAWING(S) - The figure shows the sectional view of the equipment. (1) pressurized container; (2,3) vertical components; (5) sealing unit; (6) elevation unit; (7A) support stand, (A) silicon substrate.

CHOSEN-DRAWING: Dwg.1/5

TITLE-TERMS:

PRESSURE TREAT EQUIPMENT PLATE SHAPE BODY SILICON WAFER  
HANDLE ROBOT  
PERFORMANCE INSERT REMOVE SILICON WAFER PROCESS CHAMBER  
DIVIDE VERTICAL  
COMPONENT CONTAINER

DERWENT-CLASS: U11

EPI-CODES: U11-F02A1;

SECONDARY-ACC-NO:

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]**

**[0001]**

[The technical field to which invention belongs] this invention relates to the high-pressure-gas processor used when the high-pressure-gas processor for performing degreasing processing using processing of \*\*\*\* press (HIP) processings, such as between heat, high-pressure-gas oxidization, nitriding, etc., etc. and the fluid of the super-critical state, i.e., a processed material, serves as batch processing in solid form. Especially, the processed material of the tabular of Si wafer etc. is related with the tabular object pressure treater for processing one sheet at a time in a short cycle.

**[0002]**

[Description of the Prior Art] Several 100 kgf/cm<sup>2</sup> Although there are various things in the process and technology of processing a solid-state using the above high pressure gas, HIP processing is raised as the typical thing, and it is already industrially used in removal of the pore-like defect inside the cast of various alloys, removal of the remains pore inside the sintered product represented by cemented carbide, etc.

[0003] In HIP processing, without the purpose deteriorating a processed article also under an elevated temperature, it is in compressing a processed article by the pressure of gas, and gas with a completely inactive argon etc. is used. Moreover, the way open the usual HIP processing wide and it takes the top cover or lower lid of a longwise pressurized container in and out the whole fixture after it is considered so that they may contain the processed material of many in one processing as possible in equipment, since the processing times are several hours - one day, and long batch processing, and there has also been the processing time for a long time and it contains a processed article to the fixture of exclusive use about receipts and payments of a processed article is taken.

[0004] It follows on detailed-ization of ULSI recently. moreover, after the aluminum wiring film formation on Si semiconductor wafer The problem that aluminum is not buried with the contact hole (hole for energization) formed in the lower part has come out. as this solution technique At the temperature of 400-500 degrees C 500 to 1000 kgf/cm<sup>2</sup> The pressurization embedding method process under high-pressure argon gas atmosphere, and this hole is fill uped with aluminum is capturing the spotlight.

[0005] In this case, the method which puts in one wafer at a time in a pressurized container is adopted from the request which performs pressurization embedding processing by this film formation and continuation by the so-called single wafer processing to which formation of the wiring film by the sputtering method processes one wafer at a time. As equipment for this, the equipment proposed by \*\*\*\*\* 7-502376 is well-known. Although it has structure which the supporter which receives a wafer on a lower container (bottom housing portion), and a bottom container goes up and down although every [ wafer 1 sheet (work piece) ] is taken in and out of the exterior of a pressurized container with this equipment, the wafer itself is transported to inside from from outside a container how, i.e., about whether in-and-out of the tabular object which is a processed material in a processing room is enabled, it is not indicated but is unknown.

[0006]

[Problem(s) to be Solved by the Invention] In the case of above-mentioned HIP equipment, there are no big time restrictions to the work which opens and closes the lid of equipment and takes out a processed article. Moreover, although a processed article is put into a container-like fixture and receipts and payments into equipment are carried out in many cases by the help, he has no container-like fixture etc. in the product (tabular object) of the shape of sheet metal, such as Si wafer set as the main object of this invention. A mechanism which puts on the processed article holder in direct equipment, or is taken out is not established, but such processing is impossible on parenchyma.

[0007] Moreover, with the equipment shown in \*\*\*\*\* 7-502376, although there is no detailed publication about handling of Si wafer of a processed article, it is accompanied by operation of dropping a lower part housing portion, in the cylinder which operates by the connection tube and pneumatic pressure of drawing 5 in the official report concerned. Since the structure of making the processing room shell exterior opening a member like a connection tube for free passage is included so that clearly from drawing, the gas-seal mechanism in this portion is needed, and it is inherent in the problem of the composition of equipment being complicated and being easy to generate troubles, such as gas leakage.

[0008] Moreover, in order to deliver a processed wafer-like article from the susceptor in equipment, operation of lowering the wafer which a wafer is usually floated from a susceptor, and inserted the fork-like handling arm in the crevice made between the wafer and the susceptor, and was being floated in it, and putting on this handling arm is required. The actuator for for that carrying out vertical movement of the wafer is required, and it is required to form this actuator in the processing room space of high-pressure-gas atmosphere, to prepare in the exterior of a processing room with a gestalt like drawing 5, or to take one of means.

[0009] In there being the problem as \*\*\*\*\* 7-502376 that it is the same when preparing outside and preparing in the interior, a driving source like an electric motor will be used under high-pressure-gas atmosphere, a special motor is required and the parts for introducing into the interior of a pressurized-container external shell the lead wire which supplies the power supply for a drive become indispensable. It is the purpose that this invention offers the pressure treater of the tabular object which canceled the fault of the conventional technology like the above.

[0010]

[Means for Solving the Problem] this invention has provided the following technical means, in order to attain the above-mentioned purpose. Namely, this invention concerning a claim 1 sets one tabular object at a time within a pressurized container to the pressure treater of pressure treatment or the tabular object which carries out reaction processing. The aforementioned pressurized container consists of a container composition member of the upper and lower sides carried out at least 2 \*\*\*\*\* by the upper and lower sides of container shaft orientations. It has the portion which forms a processing room when this coalesces in the container composition member of these upper and lower sides in the division section. The aforementioned division section is equipped with a seal means to prevent the fluid leak from a processing room. It has a rise-and-fall means to go up and down a bottom container composition member to container shaft orientations among members. the aforementioned container composition -- It is characterized by having had the support means which support a tabular object in the aforementioned processing interior of a room, and having the handling robot which enables in-and-out of a tabular object to a processing room further in the state where the aforementioned division section was deserted in the side of the aforementioned pressurized container.

[0011] moreover, the aforementioned seal means [ in / a claim 1 / at this invention concerning a claim 2 ] -- lower container composition -- the field seal with which the ring object which has fitted into a part for the crevice which forms the processing room of a member, and this ring object are equipped -- it is characterized by consisting of a member and a shaft-sealing member furthermore, a rise-and-fall means go up and down the lower container composition member in a claim 1 to container shaft orientations in this invention concerning a claim 3 -- the lower container composition member concerned -- a top, a soffit, and a vertical edge -- on the way -- a position -- a halt -- possible -- this middle -- a position -- setting -- a top and bottom container composition -- it is characterized by to be formed the path where it

is deserted and the division section of a member enables in-and-out of a tabular object through a handling robot

[0012] Moreover, the support means which support the tabular object in a claim 1 in this invention concerning a claim 4 lower container composition – with the susceptor with which a part for the crevice which forms the processing room of a member is equipped the shape of \*\* [ circumference / of this susceptor ] – and the pin member which it has in the vertical direction as floating, and a top and bottom container composition – when the division section of a member is made to desert, it is characterized by consisting of springs which surface a tabular object from a susceptor through a pin member

[0013]

[Embodiments of the Invention] Hereafter, with reference to drawing, the composition of the pressure treater of the tabular object in the gestalt of operation of this invention, a function, an operation, etc. are explained. It shows one sheet at a time pressure treatment or the example of a processor which carries out reaction processing for a tabular object in drawing 1 within the pressurized container 1 by this invention. This view fills up the interior of equipment with a high pressure gas, and shows the process which is processing. In addition, the hydraulic pump for piping for supplying or discharging a high pressure gas, a compressor, the source of gas, and an oil hydraulic cylinder drive etc. is not illustrated.

[0014] the container composition of the upper and lower sides to which at least 2 \*\*\*\*s of the aforementioned pressurized containers 1 were carried out by the upper and lower sides of container shaft orientations – from members 2 and 3 – becoming – \*\*\*\* – the container composition of these upper and lower sides – when members 2 and 3 coalesce in the division section, it has the portions 2A and 3A which form the processing room 4, and the aforementioned division section is equipped with a seal means 5 to prevent the fluid leak from the processing room 4 the aforementioned container composition – the upper container which has path 2B which pours in and discharges the gas which is a pressure medium among members 2 and 3, the fluid of the super-critical state, etc. at the processing room 4 – a member 2 is fixed to the stand outside drawing – having – on the other hand – lower container composition – it has a rise-and-fall means 6 to illustrate a member 3 with the oil hydraulic cylinder which goes up and down to container shaft orientations

[0015] It had the support means 7 which support the tabular object A in the aforementioned processing room 4, and has the handling robot 8 which enables in-and-out of the tabular object A to the processing room 4 further in the state where the aforementioned division section was deserted through extension operation of the rise-and-fall means 6 in the side of the aforementioned pressurized container 1. the aforementioned seal means 5 – lower container composition – the field seal with which the slot formed in the upper-limit side of ring object 5A which has fitted into crevice part 3A which forms the processing room 4 of a member 3, and this ring object 5A is equipped – shaft sealing which has fitted into the slot formed in the periphery side of member 5B and ring object 5A – a member – it consists of 5C

[0016] the axial tension which acts in the vertical direction (container shaft orientations) when carrying out pressure treatment of the Si wafer A in the tabular object and this example put on support means 7 at the processing room 4 of a pressurized container 1 – lower container composition – the cotter 10 which frequents the inferior surface of tongue of a member 3 in the direction of the diameter of a container by the operation of the drive cylinder 9, and upper container composition – it is supported by the press frame 12 it can run freely by truck 12A through the proof-pressure board 11 grade

[0017] the load by the high pressure gas mentioned above – upper container composition – a member 2 – a top – lower container composition – a field seal [ in / the seal means 5 of a high pressure gas / since a member 3 is compressed into the bottom and the crevice between up-and-down parting planes spreads ] – a member -- O-ring as showed 5B in drawing -- a parting plane -- preparing -- shaft sealing - a member -- it is recommended that 5C uses a metallic ring this seal means 5 – the force of the high pressure gas inside a container -- O-ring of a parting plane – the elastic deformation -- always -- upper container composition -- it can become the structure which is stuck to the sealing surface of a member 2, and can follow in footsteps of expansion of the crevice by stretch of RI and the vertical direction of a press frame 12

[0018] the support means 7 which support the tabular object A – lower container composition – with susceptor 7A with which crevice part 3A which forms the processing room 4 of a member 3 is equipped the shape of \*\* [ circumference / of this susceptor 7A ] – and the pin which it has in the vertical direction as floating – a member – with 7B a top and bottom container composition – the time of making the division section of members 2 and 3 desert by the operation of the rise-and-fall means 6 etc. – a pin – a member – it consists of coil-spring 7C which surfaces the tabular object A from susceptor 7A through 7B

[0019] furthermore, upper container composition – the clamp guide 13 is being fixed to crevice part 2A of a member 2, and semipermanent [ of the vertical movement of the clamp 14 of a disk form ] is made possible to this clamp guide 13 this clamp – the tabular object A by which the member 14 is put on support means 7 does not move by flow of a pressure medium etc. – as – the clamp concerned – the tabular object A is pressed down by the weight of a member 14

[0020] lower container composition – a rise-and-fall means 6 to go up and down a member 3 to container shaft orientations It can stop in a position. the lower container composition concerned – a member 3 – a top, a soffit, and a vertical edge – on the way – this middle – a position – setting – a top and bottom container composition – it is formed as the path B which enables in-and-out of the tabular object A through the handling robot 8 with which it is deserted and the division section of members 2 and 3 has hand 8A and arm 8B shows by drawing 2 - drawing 4

[0021] It is required to open a pressurized container wide, to set a processed member (this invention Si wafer) in equipment, or to take it out first, on the occasion of actual processing. Drawing 2 and drawing 3 show typically the state of processing finishing and taking out a wafer. Thickness a mainstream wafer now Although 0.5 to 0.8 mm and a diameter are 20cm, in order for the 30cm thing to also have appeared and to move such a thin disc-like processed material A, recently, the wafer handling robot 8 with the hand which usually carried out the fork configuration, and an arm is used.

[0022] first, the lower container composition after processing finishing and making the pressure of the processing room 4 almost the same as the pressure (usually atmospheric pressure or reduced pressure) of the pressurized-container exterior – the rise-and-fall means 6 which shows a member 3 with the oil hydraulic cylinder for lower container rise and fall is driven, and it depresses caudad the wafer receptacle pin incorporating spring 7C with the repulsive force of a grade which susceptor 7A of Si wafer is prepared [ repulsive force ] in the processing room 4, and has Si wafer lifted – a member – it is equipped with 7B moreover, the clamp of the above-mentioned wafer – it carries out semipermanent [ of the member 14 ] so that it can fluctuate about 10-30mm to an upper container side – having – \*\*\*\* – lower container composition – if a member 3 descends – a clamp – the soffit which a member 14 can move [ the ] – stopping – the elasticity of spring 7C of the above [ Si wafer ] – a wafer receptacle pin -- a member – it is raised when 7B goes up further – lower container composition – the state ( drawing 2 ) where it became the grade by which a member 3 is dropped and the above-mentioned wafer handling robot's 8 arm nose of cam goes into a wafer inferior surface of tongue and the crevice between Si wafer susceptor 7A – once – lower container composition – movement in the lower part of a member 3 is stopped, and the wafer handling robot's 8 arm is inserted into the bottom of Si wafer as drawing 5 shows subsequently – again – lower container composition – if a member 3 is moved caudad, Si wafer will be put on the wafer handling robot's 8 hand portion ( drawing 3 ) Wafer A is taken out by pulling out the wafer handling robot 8 to the pressurized-container section exterior in this state ( drawing 4 ). When setting Si wafer in a pressurized container, it can carry out by performing operation of these series conversely.

[0023] In the above explanation, as shown in drawing, even if the oil hydraulic cylinder for a lower container drive transposes the whole cotter to an oil hydraulic cylinder or a gas \*\* cylinder as well as 1 or already kicking two or more on the outside of a press frame, the same effect can be acquired and this is also within the limits of this invention. In this case, neither these oil hydraulic cylinders nor a gas \*\* cylinder can be overemphasized by that it is necessary to use sufficient withstand load to support the axial load generated with the pressure in a high pressure vessel at the time of processing.

[0024] Moreover, wafer susceptor 7A is also recommended incorporating an electrostatic chuck and

fixing Wafer A. In this case, the grade heavier than the spring force of wafer receptacle pin 7B of the wafer clamp material 14 is lightweight, and it is enough. Furthermore, although the illustration ellipsis was carried out at susceptor 7A, heater element, such as a tabular heater, possesses.

[0025] in addition – the seal means 5 – upper container composition – it carries out, and about the handling robot 8, it may be accompanied by rise-and-fall operation, and including in a member 2 can also make [ possible ] this further Kannon starting a ceremony instead of a truck formula about a press frame 12 Moreover, about a pressurized container 1, it is desirable to be also able to use this periphery as a vacuum chamber and to consider as the bellows composition which follows the movement of container shaft orientations at this time.

[0026]

[Effect of the Invention] The thing which were described above and for which a wafer is taken in and out of a pressurized container becomes possible by this invention like, without installing a motor and the actuator for wafer movement of gas \*\*\*\*\* in the interior of a pressurized container. Especially the thing that an actuator which has the sliding section exists near the Si wafer in order that generating of particle (dust) may reduce the quality of a processed article in the process which processes Si wafer used for ULSI etc. is not desirable. That is, it is not desirable that such an actuator exists in a pressurized container with the equipment used in atmosphere, such as high-pressure gas, like this invention. However, the effect of Si wafer which is a processed material being moved has one very large if actuators, such as a motor, are not used in fact with it difficult [ to move a processed material ] in many cases, without forming actuators, such as such meter, in the interior of a pressurized container by this invention, although it is the actual condition.

[0027] In connection with the future densification of ULSI, it is expected that various use, such as a pressurization pad of a wiring film, high-pressure oxidization, high-pressure nitriding, a high-pressure reflow of an insulating oxide film, and super-criticality washing, spreads, and it is thought that the place which this invention contributes is large.

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[Translation done.]

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1] It is the cross section having shown under pressure treatment typically.

[Drawing 2] It is the cross section having shown the time of penetration of the handling robot after pressure treatment.

[Drawing 3] It is the cross section having shown \*\*\*\*\* of the tabular object by the handling robot after pressure treatment.

[Drawing 4] It is the cross section having shown the cash drawer (drawing) of the tabular object by the handling robot after pressure treatment.

[Drawing 5] It is the C-C \*\*\*\* view of drawing 3 .

[Description of Notations]

1 Pressurized Container

2 Upper Container Composition – Member

3 Lower Container Composition – Member

4 Processing Room

5 Seal Means

6 Rise-and-Fall Means

7 Support Means

8 Handling Robot

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[Translation done.]



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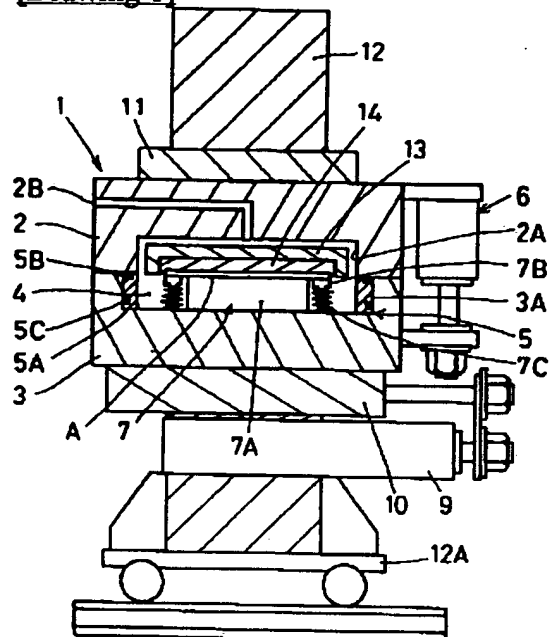
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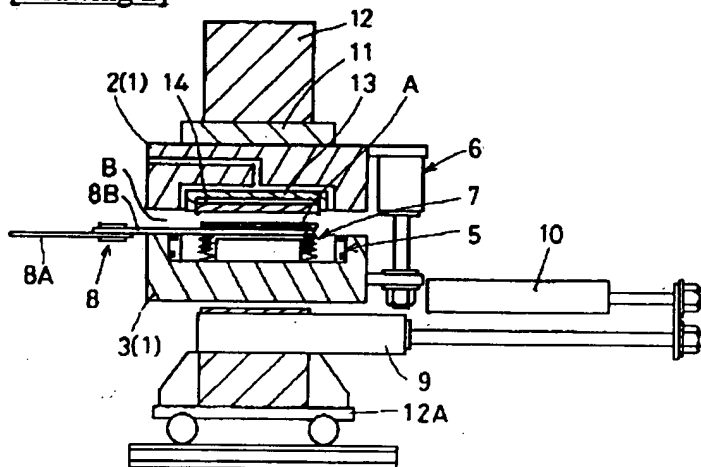
**DRAWINGS**

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**[Drawing 1]**



**[Drawing 2]**



**[Drawing 3]**

